METHOD OF CONTROLLING PUMP USED IN INK JET PRINTER

CLAIMS

[Claim(s)]

[Claim 1] A control method of a pump of an ink jet printer characterized by making ink discharge from said ink jet arm head by decreasing a pressure gradually after a pressure which drives said pump and this pump generates in a control method of a pump of an ink jet printer characterized by providing the following reaches a predetermined pressure An ink supply way for supplying ink to an ink jet arm head which injects ink from an ink cartridge which stored ink Ink exhaust passage for discharging ink which is not contributed to record A pump formed in this a part of ink exhaust passage in order to generate a pressure in this ink exhaust passage

[Claim 2] It is the flexible tube with which said pump constitutes said a part of ink exhaust passage in claim 1. A roller which is supported by body of revolution, flexibility-tube [this]-sequential-presses, and follows and deforms into rotation of this body of revolution It is the control method of a pump of an ink jet printer equipped with the above, and after rotating said body of revolution with the 1st rotational speed, it is made to rotate with rotational speed with the 2nd rotational speed lower than the 1st rotational speed, and is characterized by making ink discharge from said ink jet arm head.

[Claim 3] A control method of a pump of an ink jet printer characterized by stopping said pump after making it rotate with said 2nd rotational speed and making it rotate gradually with a rotational speed lower than the last rotational speed at a speed still lower than the 2nd rotational speed in claim 2.

[Claim 4] A control method of a pump of an ink jet printer that time amount rotated with a rotational speed lower than the last rotational speed is characterized by short thing in claim 2 or claim 3 compared with time amount rotated with the last rotational speed.

[Claim 5] An ink jet printer characterized by providing the following An ink supply way for supplying ink to an ink jet arm head which injects ink from an ink cartridge which stored ink Ink exhaust passage for discharging ink which is not contributed to record A controller

which makes ink discharge from said ink jet arm head by decreasing a pressure gradually after a pressure which drives said pump and this pump generates in an ink jet printer possessing a pump formed in this a part of ink exhaust passage reaches a predetermined pressure, in order to generate a pressure in this ink exhaust passage

[Claim 6] It is the flexible tube with which said pump constitutes said a part of ink exhaust passage in claim 5. A roller which is supported by body of revolution, flexibility-tube [this]-sequential-presses, and follows and deforms into rotation of this body of revolution It is the ink jet printer equipped with the above, and after rotating said body of revolution with the 1st rotational speed, it is made to rotate with rotational speed with the 2nd rotational speed lower than the 1st rotational speed, and is characterized by having a controller which makes ink discharge from said ink jet arm head.

[Claim 7] An ink jet printer characterized by having a controller made to suspend said pump after making it rotate with said 2nd rotational speed and making it rotate gradually with a rotational speed lower than the last rotational speed at a speed still lower than the 2nd rotational speed in claim 6.

[Claim 8] An ink jet printer characterized by having a controller which drives said pump so that time amount rotated with a rotational speed lower than the last rotational speed may become short in claim 6 or claim 7 compared with time amount rotated with the last rotational speed.

[Claim 9] An ink jet printer characterized by having had a pulse motor for rotating said body of revolution in one of terms according to claim 6 to 8, and having a controller which drives said pulse motor based on a control table on which a rotational frequency of this pulse motor was described.

[Claim 10] A roller arranged in one of terms according to claim 6 to 9 in the first half at body of revolution of a pump is an ink jet printer characterized by being 1 or two pieces.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the control method of pumping plant and pumping plant which discharges in more detail the air bubbles contained in the ink in the ink supply way from an ink cartridge to an ink jet arm head about the ink jet printer which injects ink from an ink jet arm head, and is recorded on a record member.

[0002]

[Description of the Prior Art] In the ink jet printer, supply of the ink to an ink jet arm head uses the ink cartridge of an exchange type. At the time of exchange of an ink cartridge, air bubbles mix in an ink supply way from the exchange section. On the other hand, the ink jet

arm head of a drop method on demand will cause the regurgitation impossible of ink, if air bubbles flow into the pressure generating interior of a room.

[0003] Many pumping plant only for ink jet printers is proposed as a recovery device for discharging such air bubbles. In such pumping plant, the pumping plant which opened for free passage with a cap the nozzle which is the ink discharge opening of an ink jet arm head on the cover and the cap is driven, ink is attracted from a nozzle using the pressure (negative pressure) which pumping plant generates, and what discharges harmful air bubbles with ink is known.

[0004] It has the body of revolution which supports the roller which pressurizes the flexible tube laid in one of the pumps used for such a recovery device in the shape of a circle along with a guide which is indicated by JP,6-286158,A and JP,4-261864,A, and this flexible tube, and the tube pump which generates a pressure using deformation of a tube is proposed.

[0005] With such a tube pump, by rotating body of revolution, a roller moves a flexible tube with push crushing one by one, and, thereby, negative pressure is generated in a tube. Body of revolution is driven through the gear train by the pulse motor by which a ******** roll control is carried out to the control means of an ink jet printer at the information memorized beforehand.

[0006] Migration and discharge are so easy for the air bubbles in ink passage that the ink rate of flow is large. Moreover, it depends for the ink rate of flow in ink passage on the magnitude of the negative pressure generated with pumping plant. Therefore, generating the made big negative pressure to restrict was the policy which discharges air bubbles certainly in the efficient, i.e., are few, amount of ink again for a short time. Then, overcoming pumping plant at a rotation load for a roller crushing a flexible tube one by one and inertia, and rotating body of revolution with the maximum pivotable rotational speed has been performed.

[0007] On the other hand, an ink cartridge to the ink jet arm head connects and constitutes various components, such as a damper member and a head case, at the serial in the ink tube to which ink is led, the filter member which removes the foreign matter in ink, the damper member which eases the ink pressure fluctuation by migration of carriage, and the pan from the ink needle which penetrates to a cartridge and extracts ink, and an ink needle to carriage.

[0008] Moreover, the pumping plant for the ink jets of a piston method is indicated by JP,4-347655,A.

[0009]

[Problem(s) to be Solved by the Invention] Moreover, the ink passage which consisted of above various components is difficult for the elementary stream of ink to change continuously on components manufacture, namely, to constitute that connection section of components of each so that an ink passage cross section may change smoothly. Therefore, the ink elementary stream of the connection section of each part article is not continuous,

and serves as discontinuous ink passage which the so-called stagnation generates.

[0010] Moreover, a filter member uses the mesh which consists of detailed puncturing quite smaller than the size of a nozzle in many cases. Even if this filter member captures a foreign matter and a certain puncturing blockades it, a large area is given so that many other puncturing can be secured. Therefore, the ink passage of the arrangement section of a filter member has the partially large cross section, and the filter section serves as passage where ink stagnates most among ink passage.

[0011] As mentioned above, pumping plant is used in order to discharge air bubbles from such ink passage.

[0012] However, if air bubbles enter into the stagnation section of ink, even if it will carry out continuation rotation of the pump with the maximum rotational speed, as shown in about [that air bubbles are not discharged] and drawing 20 , air bubbles are put out in small quantities and it has the technical problem that the regurgitation of ink gets worse by activation of pump actuation.

[0013] Moreover, in the pumping plant of a piston method, since there is no accumulation of a structure top pressure, the negative pressure which a pump generates in one round trip of a piston is determined. However, in order to discharge air bubbles in the above-mentioned ink passage, it is necessary to carry out a number round trip at least from the capacity change by migration of a piston. In the pump which a pressure does not accumulate, developed pressure goes back and forth between atmospheric pressure and negative pressure for every stroke, and developed pressure ripples it. When stagnation exists in ink passage and air bubbles exist in the stagnation section, in spite of these air bubbles' being divided by pulsation, being [air bubbles] easy and carrying out pump actuation, air bubbles flow into an arm head and the recoverability of printing falls remarkably.

[0014]

[Means for Solving the Problem] An ink supply way for this invention to supply ink to an ink jet arm head which injects ink from an ink cartridge which stored ink, in order to solve the above-mentioned technical problem, In a control method of a pump of an ink jet printer of having provided a pump formed in this a part of ink exhaust passage in order to generate a pressure in ink exhaust passage for discharging ink which is not contributed to record, and this ink exhaust passage Said pump is driven, and after a pressure which this pump generates reaches a predetermined pressure, it is characterized by making ink discharge from said ink jet arm head by decreasing a pressure gradually.

[0015] Moreover, an ink supply way for an ink jet printer of this invention to supply ink to an ink jet arm head which injects ink from an ink cartridge which stored ink, In an ink jet printer possessing a pump formed in this a part of ink exhaust passage in order to generate a pressure in ink exhaust passage for discharging ink which is not contributed to record, and this ink exhaust passage Said pump is driven, and after a pressure which this pump generates reaches a predetermined pressure, it is characterized by having a controller

which makes ink discharge from said ink jet arm head by decreasing a pressure gradually.

[0016] According to such a configuration, even if it is the ink passage where the so-called stagnation from which an ink passage cross section changes in discontinuous exists, a pressure which a pump generates reaches a predetermined pressure and discharge of comparatively big air bubbles which accumulated in the stagnation section in ink passage is performed. While rotating by this predetermined pressure, air bubbles do not need to be discharged completely. While rotating by predetermined pressure, big air bubbles are divided by detailed air bubbles, and are carrying out Koide all over ink passage. Then, the rate of flow of ink falls gradually by decreasing a pressure gradually. A pressure committed by the fall of the ink rate of flow to air bubbles which were ****ing in the stagnation section also decreases. Therefore, a bit of air bubbles to down-stream ink passage is lost. That is, although air bubbles remain in the stagnation section, air bubbles can prevent flowing into an ink jet arm head side by decreasing a pressure gradually. Therefore, a pump is suspended as it is, recovery is ended, and even if it prints, the poor regurgitation of ink is not generated.

[0017] A tube pump equipped with a flexible tube which is the pump of a continuation rotary system with which a pressure is accumulated, for example, constitutes said a part of ink exhaust passage, and a roller which is supported by body of revolution, flexibility-tube [this]-sequential-presses, and follows and deforms into rotation of this body of revolution is suitable for a desirable gestalt of a pump applied to this invention by carrying out the continuation rotation drive of the pump. When such a pump is used for this, pressure pulsation under pump suction is because it is possible to make it remarkably small.

[0018] What is necessary is to make it rotate with rotational speed with the 2nd rotational speed lower than the 1st rotational speed, and just to make ink discharge from said ink jet arm head, when such a pump is adopted, after rotating said body of revolution with the 1st rotational speed. Moreover, said pump may be stopped, after making it rotate with said 2nd rotational speed and making it rotate gradually with a rotational speed lower than the last rotational speed at a speed still lower than the 2nd rotational speed.

[0019] This discharges comparatively big air bubbles which accumulated in the stagnation section in ink passage by making it rotate with the 1st rotational speed. While rotating with this 1st rotational speed, these air bubbles do not need to be discharged completely. It is whenever [rotation / of ** a 1st], and while rotating, big air bubbles are divided by detailed air bubbles, and are carrying out Koide all over ink passage. If pumping plant is continuously rotated with the 2nd rotational speed later than the 1st rotational speed after this, the ink rate of flow will fall continuously according to a rotational-speed ratio. A pressure committed by the fall of the ink rate of flow to air bubbles which were ****ing in the stagnation section also decreases. Therefore, a bit of air bubbles to down-stream ink passage is lost. That is, although air bubbles remain in the stagnation section, air bubbles are not flowed into an ink jet arm head side while rotating with the 2nd rotational speed or a

rotational speed later than it. Therefore, if a pump is stopped after making it rotate gradually with a rotational speed lower than the last rotational speed, even if it prints after that, the poor regurgitation of ink will not be generated.

[0020] In order to rotate said body of revolution, a pulse motor is used, and if it is made to drive said pulse motor based on a control table on which a rotational frequency of this pulse motor was described, a pressure in ink passage is gradually controllable with a sufficient precision. That is, achievement of not only two steps but three steps and four steps of gradual pump suction is attained easily. That is, discharge of air bubbles becomes possible [the same thing as the number of parts of difficult ink passage for which number-of-stages preparations are made]. Also in difficult ink passage of cellular discharge, discharge of air bubbles is efficiently attained by these control.

[0021] Moreover, there is a possibility that air bubbles long beyond necessity which ink not only being wasted but a pressure accumulated when carrying out time amount rotation, a pressure was improved gradually, and were ****ing in the stagnation section again may flow out even if it is rotating a pump with a low rotational speed rather than a preceding paragraph story, when decreasing rotational speed gradually, in order to decrease a pressure which a pump generates gradually using a pump of a continuation rotary system. Such fault can be prevented if time amount rotated with a rotational speed lower than rotational speed of a preceding paragraph story is made to shorten compared with time amount rotated with rotational speed of a preceding paragraph story.

[0022] Therefore, according to this invention, also in an ink jet printer which has an ink supply path of having a complicated configuration, after operating a pump and performing recovery (discharge of air bubbles), an ink jet printer without a dot omission induced when air bubbles remain in an ink jet arm head can be offered. Moreover, it becomes compaction of operating time of a pump is possible and possible to reduce waste of ink by pump actuation further. Moreover, it becomes unnecessary from ink passage to discharge air bubbles completely, and flexibility increases in a configuration of ink passage. A filter member which is easy to serve as especially stagnation of an ink flow can secure sufficient area now, and becomes possible [prolonging a life of an ink jet printer sharply].

[0023]

[Embodiment of the Invention] (Explanation of the outline of equipment) An example of ink jet printer ** to which this invention is applied is explained using drawing 1 and drawing 9 . Drawing 1 is the schematic diagram showing an example of the ink jet printer with which this invention is applied.

[0024] The ink jet arm head 1 (it illustrates to drawing 9) is carried in carriage 12, is guided with the guide shaft 14, and moves through a belt 19 by the carriage motor 13. Cap 17 is for performing capping of nozzle 11A (it illustrates to drawing 9) of the ink jet arm head 11. The flexible tube 103 which is the component of the tube pump 15 is connected to the cap 17. The tube pump 15 is driven by the pulse motor 18.

[0025] Drawing 9 is explanatory drawing showing the outline of actuation of the tube pump 15 carried in the printer shown in drawing 1 . A tube 103 forms ink exhaust passage, the end is connected to cap 17, and the other end is connected to the waste ink cartridge 30. While a roller 105 rotates in the direction of b by rotating body of revolution 104 in the direction of arrow head a focusing on shaft 104a, sequential pressurization of the tube 103 laid in circle-like guide 106A is carried out. Thereby, a tube deforms, the ink in nozzle 11A is attracted through a cap with the negative pressure generated in the tube 103, and the unnecessary ink in which air bubbles were intermingled is discharged by the waste ink cartridge.

[0026] Although illustration has not been carried out, it has also about the control means for controlling the carriage motor 13, the pulse motor 18 which drives a pump, and the ink jet arm head 11, various drive information is memorized by the control means of the pulse motor 13 which drives especially a pump, and the roll control of a ****** pump is carried out to this information. For example, control of a pump is performed by CPU which manages control of the whole printer based on the rotational speed prepared in ROM etc., the table on which the rotational frequency was described, and the program the sequence was described to be.

[0027] (Explanation of the supply way of ink) Next drawing 17 and drawing 18 are used and an ink supply way is explained. Drawing 17 is the schematic diagram showing the ink supply way for supplying ink to the ink jet arm head 11 from the ink cartridge of the ink jet printer shown in drawing 1 .

[0028] 300 in drawing is penetrated to an ink cartridge, and 301 is penetrated to an ink cartridge, and the ink needle which takes out ink, the ink tube with which 302 introduces ink into carriage 12 from an ink needle, and 303 are damper members which ease turbulence of the ink pressure by conveyance of carriage, and it connects with the ink jet arm head 11. Heat welding of the filter member 304 which filters the foreign matter in the ink leading to plugging of the nozzle of the ink jet arm head 11 is carried out to the ink passage inside the damper member 303.

[0029] Drawing 18 is drawing showing the ink passage cross section of the damper member 303. The ink needle 301 is a product made from stainless steel, an appearance is 1.2mm and a bore is 0.9mm. On the other hand, the bore of the ink tube 302 is 2mm, and an appearance is 3mm. In order to connect the ink tube 302 with this ink needle 301, it uses connection Bush 305. Although the connection bush 305 is connected by pressing the outer-diameter section of the ink needle 301 and the ink tube 302 fit, since bores differ, level difference 305A to which an ink flow stagnates produces the ink needle 301 and the ink tube 302. The ink tube 302 uses O ring 306A for the damper member 303, and is connected with it. The filter member 304 furthermore stuck on the ink passage of the damper member 303 is stuck on the location where it is immersed in ink ****** inside the damper member 303.

[0030] A large area is given so that the filter member 304 can secure sufficient puncturing, even if an ink jet printer will be used by the life and many foreign matters will be filtered, since the puncturing is blockaded if the foreign matter in ink is filtered. In the ink jet printer of this example, the area of the filter member 304 needs the area of 100 times or more of the ink tube 302. Therefore, in ink suction by pump actuation, the average ink rate of flow of the filter section 304 becomes 1/100 or less [of the ink tube 302].

[0031] Ink room 303A is prepared in the rear face of the filter member 304 by which welding was carried out to the damper member 303. Ink room 303A is the same passage cross section as the filter member 304. Therefore, the ink rate of flow of ink room 303A is also the about 1/100 rate of flow to the ink tube 302. Furthermore, connection passage 303B which has a passage cross section comparable as the ink tube 302 is prepared in the upper section of ink room 304A. In order to connect ink installation pipe 11F of the ink jet arm head 11 with connection passage 303B, O ring 306B uses, and it is **********.

[0032] The level difference from which connection passage 304B and the connection of ink installation pipe 11F also serve as stagnation of an ink flow exists. The ink jet arm head 11 constitutes the ink jet arm head 11 from pasting up head case 11B of resin molding, and head chip 11C which injects ink. Head chip 11C is equipped with ink installation hole 11D. Ink installation pipe 11A is formed in head case 11B in one, and forms the ink passage to ink installation hole 11D of head chip 11C further. Moreover, in the middle of ink passage, heat welding of the head filter 307 is carried out. Although the head filter 307 is smaller than the filter member 304 of the damper member 303 above-mentioned interior, a too large area can be given and the rate of flow falls [the ink rate of flow before and behind the head filter 307] as compared with the ink tube 302. Moreover, a passage cross section changes to the connection of ink installation hole 11D of head chip 11C, and head case 11B rapidly, and level difference 11E used as the stagnation of ink exists.

[0033] In order for air bubbles to mix in the ink supply way 302 from the exchange section which consists of an ink needle 301 and a connection bush 305, before printing the air bubbles which float on the ink supply way 302 at least, with cap 17, a cover and a pump 15 need to be used for them at the time of exchange of an ink cartridge 300, and they need to remove the nozzle of the ink jet arm head 11 from the ink supply way 302 at it.

[0034] (Explanation of the structure of a pump) Drawing 2 is the decomposition perspective diagram showing the configuration of an example of the tube pump 15 in the ink jet printer in drawing 1 , and drawing 3 is an assembly perspective diagram which shows a part for the principal part of the tube pump 15 in drawing 2 .

[0035] This tube pump 15 consists of the guide member 106, a tube 103, a roller 105, a lever 107, body of revolution 104, and a torsion spring 108. The tube 103 has flexibility at least in the pressurized portion pressurized with a roller 105. This pressurized portion is laid in guide side 106A (shown in drawing 4) of the shape of a circle formed in the wall of the tubed guide member 106 so that it may be smoothly pressurized one by one with a roller

105. The 103A side of a tube 103 is connected to a cap. On the other hand, after the 103B side is guided at guide 106D of the shape of a circle by the side of the base of the guide member 106, it is connected to a waste ink cartridge.

[0036] Shank part 105A of a roller 105 is attached in the groove cam 109 of a lever 107 at the pivotable condition. The groove cam 109 in which shank part 105A of a roller is attached is formed in the lever 107 for supporting a roller 105. This cam 109 is in the condition that the lever 107 was included in body of revolution 104, and has the configuration which inclined to the circumferencial direction of body of revolution. That is, the distance from body-of-revolution 104 center to one edge of a cam groove 109 differs from the distance to an other end. Axis-of-rotation 107B is inserted in hole 104B prepared in the rotation member 104 to shaft 104A by which rotation hole 107A and axis-of-rotation 107B were prepared on the same line at the lever 107, and rotation hole 107A was prepared in body of revolution 104, respectively.

[0037] thereby, a lever 107 is looked like [body of revolution 104] rotatable, and is attached in it. Moreover, stopper pin 107C (it illustrates to drawing 4) for regulating in a fixed range has prepared rotation of the lever 107 energized by the outside of body of revolution 104 with the torsion spring 108 mentioned later in the field by the side of the body of revolution of a lever 107. This stopper pin 107C is inserted in stopper hole 104D of body of revolution 104, and when the stopper pin 107 contacts the wall surface of hole 104D, rotation of a lever 107 is regulated below at a constant rate.

[0038] A double torsion type spring is used and the torsion spring 108 is loosely inserted in the periphery of cylinder shaft 104E prepared in body of revolution for the coil section. The spring 108 is attached in body of revolution 104 so that arm 108A of the torsion spring 108 may contact spring receptacle pillar 104F prepared in body of revolution 104 and two arms 108B of the both ends of a spring 108 may contact spring receptacle section 107D (it illustrates to drawing 4) of a lever 107.

[0039] Drawing 4 is the cross section of the portion of the lever 107 of the pump shown in drawing 2 . A tube 103 is pressed by the roller 105, when end 109A of the groove roller cam section 109 is in the most distant location from axis-of-rotation 104C of the inside of a cam curve, and body of revolution 104 and shaft 105A of a roller is in this location (it is called the 1st location and a following actuated position). Moreover, when other end 109B of the roller cam section 109 is in the location nearest to axis-of-rotation 104C of body of revolution 104 and shaft 105A of a roller is in this location (it is called the 2nd location and a following shunting location), the press to a tube can be loosened.

[0040] if a roller 105 will move to an actuated position along with the cam curve 109 of a lever 107 if body of revolution 104 rotates in the positive direction (the direction of a), and it rotates to hard flow (the direction of b), a roller 105 will be boiled and moved to a shunting location. When a roller is in an actuated position and carries out the sequential press of the tube, stopper pin 107C is separated from the wall surface of hole 104D, and a tube is

pressed by the elastic force of a spring 108. In addition, the spring 108 is beforehand set as suitable elastic force so that the force required to set space inside [tube] the pressed portion of a tube 103 to 0 may be acquired.

[0041] On the other hand, when a roller is in a shunting location, stopper pin 107C contacts the wall surface of hole 104D, inhibits rotation of a lever 107, and prevents a roller from pressing [105] a tube 103. In addition, it does not call at the hand of cut of body of revolution 104, but as shown in drawing 4 , also when it is in the location from which the roller 105 separated from circle-like guide 106A, rotation of a lever 107 is regulated by stopper pin 107C.

[0042] The distance L1 from the center of axis-of-rotation 104C of the body of revolution 104 in case a roller 105 is in a shunting location here to the tubeside of a roller 105 is > (distance L1) (distance L2) so much to the distance L2 by the side of the axis of rotation of the center of axis-of-rotation 104C to the tube 103.... (1)

It is set up so that the becoming conditions may be fulfilled.

[0043] That is, even if a roller 105 is in a shunting location, press of a tube is not canceled completely but touches the tube. However, in the contact section of the tube 103 of a roller 105, inside the tube, the location of a stopper pin is beforehand defined so that a sufficient room may be obtained. As shown in drawing 2 , body of revolution 104 is attached in the guide member 106 of a tubed configuration so pivotable. Moreover, the gear 120 is formed in one at the lower part of body of revolution 104, and body of revolution 104 rotates in positive reverse both directions through the idle gear (un-illustrating) connected to the gear 120 by driving a pulse motor 18 (it illustrating to drawing 1).

[0044] Hole 106B which receives shaft 104C of a rotation member is formed in the guide member 106. Moreover, along with guide 106D, the tube 103 is guided at the reverse side of the field where it is equipped with the body of revolution 104 of the guide member 106. The valve 110 of the T character mold which blockades a tube 103 is attached in this field of the guide member 106 rotatable focusing on shaft 106C prepared in the guide member 106.

[0045] Hole 110A of a valve 110 is a hole for attaching a valve in shaft 106C of the guide member 106. Cam 107E for operating a valve is prepared in a lever 107, when it is in the location from which the roller 105 separated from guide 106A, cam 107E presses the tip of arm 110C of a valve 110, a valve 110 is rotated and the tip of arm 110B crushes a tube 103. Even when working [of a pump] and a roller are in the location which does not press a tube by this, it is prevented that the inside of a tube 103 is wide opened by atmospheric air.

[0046] (Explanation of actuation of a pump) Next, actuation of the tube pump of this example shown in drawing 2 and drawing 3 is explained using drawing 8 from drawing 4 . It is the cross section of the portion of the lever 107 of the tube pump which shows any drawing of drawing 4 thru/or drawing 8 to drawing 2 . Drawing 4 has a roller 105 in a shunting location, and the condition of having separated and stopped from guide 106A is shown. Drawing 5 and drawing 6 show the condition of rotating in the direction (it rotating

normally henceforth) of arrow head a in which a pump generates negative pressure, and, as for drawing 7 and drawing 8 , a pump shows the condition of rotating the normal rotation direction in the direction (it reversing henceforth) of arrow head b of reverse.

[0047] If body of revolution 104 rotates in the direction of arrow head a as shown in drawing 5 from the condition of drawing 4 , a roller 105 will contact a tube 103, and if it rotates further, a roller 105 will move to an actuated position from a shunting location along with a cam 109. And press deformation of the tube is carried out until it moves to the circle-like guide 106A side gradually while a roller 105 rotates in [the direction of arrow head c] follower according to contact force with a tube 103, as shown in drawing 6 , and the space inside a tube 103 becomes 0 in the location of X of the starting point of guide 106A.

[0048] From this condition, if body of revolution 104 rotates further, by the volume change of the tube crushed with the roller, negative pressure will occur and suction actuation of a nozzle will be performed. In addition, in the upstream of X location guided to the guide member of a tube 103, the waste ink cartridge 30 to which cap 17 collects ink in the lower stream of a river of the location of Y is arranged.

[0049] Hereafter, pause actuation of a pump is explained using drawing 8 from drawing 7 . After ending suction actuation (normal rotation of a predetermined time) required for recovery of an ink jet arm head, a motor 18 is stopped and the drive of a pump is stopped. In this condition, as mentioned above, a roller 105 has a tube 103 in the condition of having been crushed by the roller 105, as shown in drawing 7 , when it is in an actuated position and a roller 105 stops between the tip X-back end Y of guide section 106A of a guide member. When left in this condition for a long period of time, it is as having mentioned above that there are problems, such as permanent deformation of a tube and deterioration of endurance. Therefore, after stopping body of revolution 104 from normal rotation, body of revolution 104 is once reversed, and after moving a roller 105 to shunting location 109B from actuated-position 109A, it is made to stop again, in order to stop a pump.

[0050] That is, the roller (drawing 7) in actuated-position 109A moves to shunting location 109B (drawing 8) by reversing body of revolution 104 (the direction of b). Thus, even if a roller 105 stops between X-Y of guide 106A as shown in drawing 8 after reversing body of revolution and stopping again, a roller 105 is in the condition of having contacted the tube 103 lightly. Even if it continues the inversion of a pump in this condition, since most tubes are not crushed, the ink attracted once will not flow backwards.

[0051] (Explanation of a valve of operation) Actuation of a roller 105 and a valve 110 is hereafter explained using drawing 12 from drawing 10 . It is the plan which saw any drawing of drawing 10 thru/or drawing 12 from the field side in which the valve 110 of the tube pump 15 shown in drawing 2 was attached, and the condition that the condition that drawing 10 has a roller 105 between the tip X-back end Y of circle-like guide 106A, and drawing 11 have a roller 105 in the back end Y of guide 106A, and drawing 12 show the condition that the roller 105 separated from guide 106A.

[0052] As for the upstream at the tip X of guide 106A, the cap 17 is connected to the guide member 106 of a tube 103 as mentioned above. Moreover, a tube 103 is extended by the near side from the back end Y of guide 106A, is guided at guide 106D, and is connected to the waste ink cartridge 30 further prepared in the downstream. The roller 105 shown in drawing 10 is in an actuated position, the sequential press of the tube on guide 106A is carried out, moving in the direction of a, and, thereby, ink is attracted from a nozzle. If a roller 105 passes the back end Y of guide 106A as shown in drawing 12 , it will go into the field (field except guide section X-Y) which cannot press a tube.

[0053] If a roller 105 reaches the back end of guide 106A as shown in drawing 11 , cam 107E prepared in the lever 107 contacts partial 110C of a valve 110, and a valve 110 will use shaft 106C as the supporting point, and will rotate it in the direction of arrow head d. Thereby, a tube 103 is crushed and blockaded by tip 110B of a valve. Then, if a roller 105 reaches at the tip of guide 106A, the restraint of cam 107E to a valve 110 will be canceled, and a valve 110 will return to the original location according to the elastic stability of the tube itself. That is, the state of obstruction by the valve is canceled.

[0054] The timing chart which shows the roller 105 at the time of the pump normal rotation described above and a series of actuation of a valve 110 to drawing 13 explains. The horizontal axis of drawing 13 expresses the angle of rotation of a pump, and an axis of ordinate expresses ON (operating state) of tube press of a roller and a valve, and the condition of OFF (shunting condition).

[0055] By the operating state, a tube blockades a roller and a valve, and it is wide opened in the state of shunting. As shown in this drawing, since [of a roller or a valve] either is always pressing the tube at least, the space in the tube of the upstream is not wide opened [pump] from a pump by the pump at the time of normal rotation at the downstream. Thus, when a roller crushes a tube in the field of location X-Y, negative pressure is generated in the tube of the pump upstream and a roller is in fields other than location X-Y, the negative pressure generated in the tube is held by blockading a tube with a valve. And the negative pressure with which the roller was held by the valve in the field of location X-Y is made to amplify again. By this repeat actuation, the negative pressure which a pump generates is accumulated with 3 rotation eye from 2 rotation eye from 1 rotation eye of a pump, and 2 rotation eye, and it is raised gradually.

[0056] That is, when a roller passes through the location which does not press down a tube, and negative pressure falls, the effectiveness of a pump does not fall [even if it is the tube pump equipped only with one roller by preparing such a valve]. Moreover, thereby, since it ends with one roller compared with the tube pump of two or more rollers, the miniaturization of a marked pump is realizable.

[0057] Moreover, if pulsation of the negative pressure generated by blockading a tube by the valve becomes small and carries out pump suction by fixed-speed rotation when a roller is in the location which does not press down a tube, fragmentation of the air bubbles which

are ****ing to the passage where ink tends to stagnate will decrease.

[0058] Although the valve 110 is formed in the downstream (waste ink cartridge side) of field X-Y crushed with the roller of a tube in this example, you may arrange to the upstream (cap side) and here where the same effect is acquired is made. Moreover, compared with the portion crushed with a roller 105, it can be soft into the portion crushed and used as the valve 110 of a tube 103, a thin tube may be used for it, the energization force in which a valve 110 crushes a tube further in this case can be made small, and the effect which can make driving torque of a pump low is done so.

[0059] (Other examples of the structure of a pump) The pump using two rollers is hereafter explained using drawing 14 thru/or drawing 16 . Drawing 14 is the cross section which saw the tube pump of other examples of this invention from the side, and drawing 15 and drawing 16 are AA cross sections of drawing 14 . The condition that drawing 16 has a roller 205 in a shunting location in the condition that drawing 15 has a roller 205 in an actuated position is shown.

[0060] The tube pump 200 consists of tubed guide member 206 grade which supports the lever 207 of the pair which supports the roller 205 of a pair, and a roller 205, the body of revolution 204 which supports each lever 207 rotatable, two springs which energize each lever 207 outside independently, and body of revolution 204 pivotable. Guide side 206A of the shape of a circle for guiding a tube 103 is formed in the wall of the tubed guide member 106.

[0061] each lever 207 looks like [the supporting point] shaft 204A prepared in body of revolution 204 rotatable to body of revolution 204, and is attached. To shaft 204C of body of revolution 204, each lever 207 is arranged so that it may become point symmetry. Two projection 204F are formed in body of revolution 204, and each spring is attached between projection 204F and a lever 207. Although two springs which energize each lever 207 independently are used in this example in order to make welding pressure of each roller 205 equal, one spring energized common to the direction which two levers 207 open may be used.

[0062] Shaft 205A of a roller 205 is attached in the lever 207 at the condition pivotable for the groove cam 109 of a lever 207. Thereby, if body of revolution 204 rotates to normal rotation (the direction of arrow head A), each roller 207 will move to an actuated position (drawing 15) in a shunting location (drawing 16), if it rotates to an inversion (the direction of arrow head B). Since the structure which moves is the same as a front example, detailed explanation is omitted.

[0063] Moreover, stopper pin 207C for regulating rotation of the lever 207 energized outside in a fixed range is prepared in the field by the side of the body of revolution 204 of each lever 207. When a roller is in a shunting location, and the stopper pin 207 contacts the wall surface of hole 204D prepared in body of revolution 204, rotation of each lever 207 is regulated below at a constant rate.

[0064] As stated above, by this example, two rollers are arranged to shaft 204C of body of revolution 204 so that it may become point symmetry. Moreover, since guide side 206A which lays a tube 103 in about 180 degrees or more as **** is formed in the wall of a guide 206, one of rollers will surely be located in the front face of guide side 206A. In addition, it is not necessary to be necessarily 180 degrees or more, and it was checked in the experiment depending on the diameter of a roller that it is satisfactory on a function even if it is 170 degrees or more.

[0065] Therefore, the valve which explained the tube pump of this example in the front example is unnecessary. Moreover, since the roller is pushing the tube at the always same speed during rotation of a pump, pulsation is not generated at all in developed pressure. Therefore, the air bubbles which ****ed to the stagnation of ink passage are divided by pulsation, and generating of the poor regurgitation of ink by pump actuation of flowing to a bit at an arm head side decreases. Moreover, a still more efficient pump can be offered by using two rollers in this way.

[0066] (The rotation drive control method of pumping plant) The control method of the pump of the ink jet printer of this invention is explained hereafter.

[0067] it mentioned above -- as -- exchange of an ink cartridge 300 -- an ink cartridge 300 -- ** -- the ink needle 301 is separated. At this time, air bubbles advance from ink hole 301A of the ink needle 301. Pumping plant is started in order to discharge these air bubbles.

[0068] Air bubbles advance into ink passage, and actuation of pumping plant will carry out predetermined time stationary rotation of the pulse motor 18 with the 1st rotational speed, if ordered from a control means. (Dozens steps to stationary rotation perform acceleration control in consideration of a friction load and inertial force.) In drawing 6 , the body of revolution 104 of the pump to which the power of a pulse motor 18 was transmitted starts rotation in the direction of arrow head a as given in actuation of the above-mentioned pumping plant. A roller 105 rotates in this stroke, crushing the field tube 103 of Y out of [X] drawing. At this time, the interior of tube 103A is decompressed from an atmospheric pressure, and attracts ink from nozzle 11A of the ink jet arm head 11 through the cap 17 connected to tube 103A. Just before a roller separates from the field of X, a valve 110 blockades a tube 103.

[0069] In this stroke, although a tube 103 does not have a volume change, since the negative pressure generated in the previous stroke remains, ink flows out in cap 17 from nozzle 11A in cap 17. Since volume increases the inside of cap 17 by this ink outflow, negative pressure becomes small and atmospheric pressure is approached. However, when the roller 105 loaded into body of revolution 104 passes through the field of X again (a valve 110 cancels press of a tube 103.), the stroke of press rotation of a tube 103 is started again, and the pressure in cap 17 starts descent.

[0070] It is checked that the negative pressure in a cap is saturated after about four to 5 rotation from rotation initiation of body of revolution 104 in the pumping plant of this

example. The pressure variation in the cap 17 at this time is shown in drawing 19 .

[0071] Next, the condition of the ink supply way at this time is explained. The air bubbles which advanced from the ink needle 301 move in the direction of the ink jet arm head 11 with ink by suction actuation from cap 17 in the inside of ink passage.

[0072] Although drawing 20 is the cross section of the connection of the damper member 303 and the ink jet arm head 11, in this connection 310, the stagnation from which an ink elementary stream surely becomes discontinuous is produced like the above-mentioned. If air bubbles reach this connection 310, as shown in drawing 20 , it will once be captured by the connection 310. The air bubbles captured by the connection 310 move so that it may dance within the level difference of a connection 310 by suction actuation of pumping plant, as shown in drawing 21 . If air bubbles collide with a passage wall, air bubbles will divide by the impact and many detailed air bubbles will be generated. When the suction pressure of a pump has pulsation, even if it continues suction of a pump for a long time, since air bubbles move so that it may dance at random, air bubbles will be easy to be divided and they will pour air bubbles to the ink jet beef fat 11 forever. Therefore, the air bubbles which float suction in ink passage as a long duration line are not discharged, and, as for the poor regurgitation of ink, after recovery is not canceled.

[0073] When body of revolution 104 exceeds ten rotations and the pressure in cap 17 is saturated, rotational speed is slowed down so that a pulse motor 18 may carry out stationary rotation with the 2nd rotational speed lower than the 1st rotational speed. The 1st and 2nd rotational-speed ratio is set up so that the pressure in the cap 17 generated by rotating with the 2nd rotational speed may become small a little from the pressure in the cap 17 generated while performing stationary rotation with the 1st rotational speed. thereby -- the pressure in a cap -- drawing 23 -- ** -- it changes so that it may decrease gradually [like].

[0074] The field of A of drawing 23 shows the pressure variation in a cap when carrying out stationary rotation with the 1st rotational speed. In addition, in this example, seven revolutions of body of revolution are carried out between Sections A. The field in [B] drawing shows the pressure variation in a cap when carrying out stationary rotation with the 2nd rotational speed, and carries out five revolutions of body of revolution in Section B. Thus, the ink rate of flow falls by decreasing the rotational speed of body of revolution from Section A to Section B. The pressure which joins the air bubbles which exist in the level difference of a connection 310 also decreases, and the detailed air bubbles put out in small quantities also decrease in number, and it stops therefore, flowing out of this portion gradually.

[0075] Thus, although the detailed air bubbles which flow into the ink jet arm head 11 side by slowing down rotational speed are lost, this 2nd rotational speed is maintained and body of revolution is rotated until these air bubbles pass nozzle 11A of the ink jet arm head 11, since the detailed air bubbles generated while carrying out stationary rotation with the 1st

rotational speed remain in an ink jet arm head.

[0076] After driving 7 rotary pumps with the 1st rotational speed (3 rotation per second) in an experiment, detailed air bubbles stopped remaining in an ink jet arm head after recovery by driving 5 rotary pumps with the 2nd rotational speed (2 rotation per second) continuously, and performing recovery.

[0077] Moreover, when the maximum negative pressure generated when stationary rotation is carried out with the 2nd rotational speed carries out stationary rotation with the 1st rotational speed, the 1st and 2nd rotational speed of body of revolution is set up so that the minimum negative pressure which a pump generates may not be exceeded. That is, as shown in drawing 23 , differential pressure deltaP is prepared between these minimum negative pressure and the maximum negative pressure. By this differential pressure, when the rotational speed of a pump is slowed down gradually, the ink rate of flow in ink passage becomes small certainly, therefore the bit of air bubbles is lost.

[0078] Thus, in order to decrease the pressure which a pump generates gradually using the pump of a continuation rotary system, when decreasing rotational speed gradually, even if it is rotating the pump with a low rotational speed rather than the preceding paragraph story, if time amount rotation is carried out, a pressure accumulates, a pressure is improved gradually ink is not only wasted, but, and there is a possibility that the air bubbles long beyond necessity which were ****ing again may flow out. For this reason, such fault can be prevented if the rotation (time amount) rotated with the rotational speed of the 2nd ** is made to shorten like this example compared with the rotation (time amount) rotated with the 1st rotational speed of a preceding paragraph story.

[0079] Moreover, since it is controlling by this example to shift to the 2nd rotational speed from the 1st rotational speed, without suspending rotation of pumping plant, a rapid change of the rate of flow which is easy to take place at the time of rotation initiation of pumping plant does not arise. Since the outflow of the air bubbles by the thing with rapid air bubbles to move does not occur by this, air bubbles remain in an ink jet arm head, and after pump actuation termination can avoid the fault that a dot omission is induced at the time of printing.

[0080] Although a flow arises by driving a pump 15 all over an ink supply way, a flow arises also by driving the ink jet arm head 11. That is, by performing the ink regurgitation, driving the ink jet arm head 11 and putting a pressure on the nozzle, negative pressure arises in an ink jet arm head, and influx supply of the ink is carried out from an ink cartridge side at an ink jet arm head.

[0081] As shown in drawing 22 , even after performing stationary rotation with the 2nd rotational speed and stopping a pump, air bubbles pile up in the connection 310 in ink passage, but since the ink rate of flow produced compared with the ink rate of flow produced at the time of pump actuation when driving the ink jet arm head 11 is slow, the air bubbles which convected in the connection 310 do not flow into the ink jet arm head 11.

[0082] (Other examples) Although this example explained one roller 105 and the tube pump which used the valve 110 as a tube pump, the same effect is acquired by carrying out two-step suction actuation of the pump also about the pumping plant using two rollers 205 shown in drawing 15 . Since a pressure pulsation does not occur as the pumping plant using two more rollers 205 shows to drawing 24 , it is possible to set the speed difference during stationary rotation as few speed difference with the 2nd step of 2nd rotational speed indicated to be stationary rotation in the section D in drawing with the 1st rotational speed equivalent to the 1st step shown at the section C in drawing. That is, even when the rotational speed of a pump is gradually slowed down by few speed difference, the effect that the ink rate of flow in ink passage can make it small certainly is acquired.

[0083] Although the example mentioned above described the example (example whose suction level difference is one place) which drives a pump using two steps of rotational speed, it is also possible to slow down gradually using three or more kinds of rotational speed. For example, it can prevent that the air bubbles of each part which air bubbles tend to **** by slowing down the rotational speed of a pump gradually as the suction level difference of only the number is prepared when two or more parts (passage level difference) which air bubbles tend to **** are all over an ink supply way flow into the ink jet arm head 11.

[0084] After carrying out a pump drive with the 1st rotational speed, a pump is made to suspend, a pump is driven with the 2nd rotational speed later after that again than the 1st rotational speed, and the same effect as the example mentioned above is acquired also by the control method (a halt is included and also it is a step control) of decelerating rotational speed gradually while suspending a pump henceforth. The pressure variation in the cap 17 at the time of driving a pump using the multistage story control which includes a halt in drawing 25 , and performing ink discharge actuation is shown.

[0085] Stationary rotation is carried out with the 1st rotational speed, and ink is attracted from an ink jet arm head (the 1st suction actuation, the section A in drawing). It is made to stop after that. ((B) The section in drawing) 2nd suction actuation is performed with the 2nd rotational speed with a rotational speed lower than the rotational speed of the time back to front. ((C) The section in drawing) It stops further (the section D in drawing), and 3rd suction actuation is performed with the 3rd rotational speed still later than last time. ((E) The section in drawing) It is made for the rotation of the body of revolution of a tube pump to be completed within 1 round about the 3rd suction actuation.

[0086] When adopting the pumping plant shown in drawing 7 of the type equipped with especially one roller 105, it is desirable to make it a roller 105 stop in the field in which the tube 103 from the field of X of drawing 7 to the field of Y is pressed. Thus, since effect of the pressure fluctuation at the time of a roller 105 separating from a tube 103 when a roller 105 stops suction of ink in the condition of crushing the ink tube 103 is not told to nozzle 11A, a pressure is given to an ink supply way also at the time of recovery termination, and it can

prevent that the air bubbles which are ****ing to the passage level difference flow out.

[0087] Moreover, application is not limited only to the tube pump mentioned above, and this invention can be applied to the pump of a continuation rotary system like a rotary method etc.

[0088]

[Effect of the Invention] According to the control method of the pumping plant of the ink jet printer of this invention By controlling the pump of an ink jet printer to decrease the pressure to generate gradually Even if the so-called stagnation section which changes in discontinuous exists in the cross section of the passage which supplies ink to an ink jet arm head Even if it prints after operating a pump and ending recovery in order not to make the air bubbles which **** there flow out in an ink jet arm head by force by operating a pump, the poor ink regurgitation is not induced with the air bubbles which remain in an arm head.

[0089] Therefore, even if discharging the air bubbles in passage completely uses simple pumping plant in the ink jet printer which has a difficult complicated ink supply path, induction of the poor regurgitation of the ink after recovery can be prevented, and it is effective in the ability to offer a reliable ink jet printer.

[0090] Moreover, it becomes possible to reduce the consumption of the ink consumed at the time of recovery. Furthermore, by recovery, it becomes unnecessary from ink passage to discharge air bubbles completely, and flexibility increases in the configuration of ink passage. The filter member which is easy to serve as especially stagnation of an ink flow can secure sufficient area now, and there is an effect it is ineffective to it being possible to prolong the life of an ink jet printer sharply.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The perspective diagram showing the outline configuration of the ink jet printer which applied this invention.

[Drawing 2] The decomposition perspective diagram showing an example of the configuration of the pumping plant applied to the ink jet printer of drawing 1 .

[Drawing 3] The perspective diagram showing the principal part of the pumping plant shown in drawing 2 .

[Drawing 4] Drawing of the pumping plant shown in drawing 3 of operation.

[Drawing 5] Drawing of the pumping plant shown in drawing 3 of operation.

[Drawing 6] Drawing of the pumping plant shown in drawing 3 of operation.

[Drawing 7] Drawing of the pumping plant shown in drawing 3 of operation.

[Drawing 8] Drawing of the pumping plant shown in drawing 3 of operation.

[Drawing 9] The conceptual diagram showing the ink exhaust passage of the ink jet printer of drawing 1 .

[Drawing 10] Drawing for a valve portion of the pumping plant shown in drawing 3 of operation.

[Drawing 11] Drawing for a valve portion of the pumping plant shown in drawing 3 of operation.

[Drawing 12] Drawing for a valve portion of the pumping plant shown in drawing 3 of operation.

[Drawing 13] The timing chart of the pumping plant shown in drawing 3 .

[Drawing 14] The decomposition perspective diagram showing other examples of the configuration of the pumping plant applied to the ink jet printer of drawing 1 .

[Drawing 15] Drawing of the tube pump shown in drawing 14 of operation.

[Drawing 16] Drawing of the tube pump shown in drawing 14 of operation.

[Drawing 17] The conceptual diagram showing the ink supply way of the ink jet printer of drawing 1 .

[Drawing 18] The cross section showing the ink supply way of the ink jet printer of drawing 1 .

[Drawing 19] The pressure vs stroke curve showing the pressure variation generated in a cap when the pump shown in drawing 3 is driven.

[Drawing 20] The cross section showing a part for the connection of an ink jet arm head and a supply way among the ink supply ways shown in drawing 18 .

[Drawing 21] The cross section showing a part for the connection of an ink jet arm head and a supply way among the ink supply ways shown in drawing 18 .

[Drawing 22] The cross section showing a part for the connection of an ink jet arm head and a supply way among the ink supply ways shown in drawing 18 .

[Drawing 23] The pressure vs stroke curve showing one example of the pump control of the ink jet printer of this invention.

[Drawing 24] The pressure vs stroke curve showing other examples of the pump control of the ink jet printer of the example of this invention.

[Drawing 25] The pressure vs stroke curve showing other examples of the pump control of the ink jet printer of the example of this invention.

[Description of Notations]

11 Ink Jet Arm Head

17 Cap

103 Tube

104 204 Body of revolution

105 205 Roller

106 206 Guide member

107 207 Lever

108 208 Torsion spring

110 Valve